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EXAMINER	
LUM, LEON YUN BON	

ART UNIT	PAPER NUMBER
1641	

NOTIFICATION DATE	DELIVERY MODE
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

Chgpatent@leydig.com

Office Action Summary	Application No.	Applicant(s)	
	10/555,729	NIE ET AL.	
	Examiner	Art Unit	
	Leon Y. Lum	1641	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *26 February 2010*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *198,199,203-207 and 210-224* is/are pending in the application.

4a) Of the above claim(s) *216 and 217* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *198,199,203-207,210-215 and 218-224* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *07 November 2005* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Status of Claims

Claims 198, 206, and 212 have been amended. Claims 1-197, 200-202, and 208-209 are canceled. Claims 216-217 are withdrawn. Claim 224 has been added. Accordingly, claims 198-199, 203-207, 210-215 and 218-224 are examined on the merits.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 198-199, 203-207, 210-215, 218, 220-221 and 223-224 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. to 6,710,366 to Lee *et al.* ("Lee") in view of U.S. Patent No. 6,207,392 to Weiss *et al.* ("Weiss").

i. Independent claims 198 and 206 are obvious

Lee describes a quantum dot with a continuous graded alloy of distinct core and shell materials in an "interface region" between the core and shell. *See* column 7, lines 17-36. In this embodiment, the center of the quantum dot is purely core material and the outer surface of the quantum dot is purely shell material, with a continuous transition of the materials in the interface region, in which the transition is an alloy of the core and shell materials. *Id.* The core and shell materials can each comprise Group IV, Group II-VI or Group IV-VI semiconductor materials, including CdSe and CdTe. *See* column 13, lines 18-31 and lines 40-51. The alloy in the transition region would therefore be CdSeTe. This transition region would necessarily comprise a band gap energy that is

non-linearly related to the molar ratio of the at least two semiconductors. Indeed, Applicant' specification suggests that the mere fact of combining two semiconductors creates this property. *See* paragraph 0054 (describing that an alloy of CdSe and CdTe would produce an emission peak wavelength outside the emission peak wavelength of either one alone). As further proof that this is the case, Applicants state that the ratio of semiconductors comprising the claimed quantum dots "can be <u>any</u> molar ratio" (emphasis added). *See* paragraph 0046. Accordingly, if any molar ratio is sufficient to produce the claimed band gap energy, then a teaching of a combination of semiconductors will produce this phenomenon.

Further regarding claim 206, Lee teaches a population of monodispersed quantum dots with a deviation of less than 5% root-mean-square. *See* column 8, lines 32-35.

Lee, however, does not teach the specific ratios of semiconductor materials claimed – i.e., $CdSe_{1-x}Te_x$.

Weiss indicates that altering the concentration of an alloy in a nanocrystal can affect the emission wavelength of the alloyed semiconductor nanocrystal. *See* column 8, line 50 to column 9, line 11.

With the foregoing description in mind, one of ordinary skill in the art would have found it obvious to optimize the specific ratios of the cited semiconductor alloy in the quantum dot since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 f.2d 272 (CCPA 1980). Here, the general conditions of the claim are taught in the prior – i.e., the

CdSeTe alloy is described by Lee. *See supra*, rejection of 198. The missing limitation is the particular ratio between Se and Te as described above. However, because Weiss indicates that tuning an alloy concentration would affect emission wavelength, the alloy concentration is a result-effective variable that can be optimized. Accordingly, in light of the *Boesch* case, the skilled artisan would have found it obvious to optimize the ratio of semiconductor material in CdSeTe in order to affect the emission wavelength of the quantum dot. Moreover, tuning the emission wavelength would be appropriate for Lee's quantum dot because the quantum dot is used for optical purposes. *See e.g.*, column 52, lines 42-45. The skilled artisan would have had a reasonable expectation of success in combining the teachings of Lee and Weiss because both references describe the same type of semiconductor materials for producing a quantum dot. *See* Weiss, column 7, lines 35-49.

Furthermore, Applicants have admitted that the claimed subject matter is prior art. *See* Specification, page 10, paragraph 0044, reciting "[s]uch semiconductors are known in the art, including for instance, $CdS_{1-x}Se_x$...wherein x is any fraction between 0 and 1." This type of admission can be relied upon in an obviousness rejection. *Riverwood Int'l Corp. v. R.A. Jones & Co.*, 324 F.3d 1346, 1354 (Fed. Cir. 2003); *see also* MPEP 2129. Accordingly, by Applicants' admission, the instant claim is obvious.

ii. Dependent claims 199 and 207 are obvious

Lee teaches that the yield of the quantum dot can be between 35% and 95%. *See* column 42, lines 14-17.

iii. Dependent claims, 203 and 224 are obvious

Lee teaches a CdSeTe alloy in the transition region, as described above. *See supra* rejection of claim 198.

iv. Dependent claims 204, 210 and 212 are obvious

Lee does not teach a biological agent conjugated to the quantum dot.

Weiss, however, describes nanocrystals bound to different affinity molecules to detect biological substances. *See* column 9, lines 14-35; column 12, lines 7-44.

With the foregoing description in mind, one of ordinary skill in the art would have found it obvious to modify Lee's quantum dots to conjugate a biological molecule thereon. The skilled artisan would have made the modification because doing so would allow the quantum dots to be used in a biological assay to detect a biological analyte. Moreover, because Lee indicates that ligands can be attached to the surface of the quantum dot, *see* Figures 1C and 1D, the skilled artisan would have had a reasonable expectation of success in conjugating Weiss's biological molecules onto Lee's quantum dots.

v. Dependent claims 205, 213 are obvious

Lee does not teach a quantum dot encapsulated within a polymer bead.

Weiss, however, describes a semiconductor nanocrystal placed in a polymer sphere. *See* column 13, line 51. This configuration helps to provide a stable probe material for biological applications. *See* column 2, lines 6-17.

With the foregoing description, one of ordinary skill in the art would have found it obvious to modify Lee's teaching to encapsulate the quantum dot within a polymer sphere. The skilled artisan would have been motivated to perform the modification

based on Weiss's description that this arrangement is helpful for producing a stable probe structure. Moreover, the skilled artisan has a reasonable expectation of success in combining the two references. *See supra* rejection of claims 198 and 206.

vi. Dependent claim 211 is obvious

Lee does not teach that the gradients vary amongst the population of quantum dots.

Weiss, however, teaches that the emission wavelength of an alloyed semiconductor nanocrystal can be tailored by adjusting the concentration of the alloys. *See* column 8, line 50 to column 9, line 11. Adjusting the alloy concentration in this manner can benefit applications that require a set of nanoparticles having different emission wavelengths, but a uniform size. *Id.* For example, having an array of nanocrystals with different emissions allows a user to perform a multiplex assay, in which different nanocrystals are bound to different affinity molecules to detect multiple biological substances. *See* column 9, lines 14-35 and column 12, lines 7-44.

With the foregoing description in mind, one of ordinary skill in the art would have found if obvious to modify Lee's population of monodispersed quantum dots by adjusting the alloy concentrations to provide different gradients between quantum dots, as taught by Weiss. The skilled artisan would have been motivated to perform this modification based on Weiss's teaching that doing so would allow one to perform a multiplex assay to simultaneously detect different biological substances. Moreover, the skilled artisan has a reasonable expectation of success in combining the two references. *See supra* rejection of claims 198 and 206.

vii. Dependent claims 214 and 215 are obvious

Weiss teaches a method of detecting an analyte by contacting a sample with a plurality of semiconductor quantum dots and detecting emitted light from the quantum dots. *See* column 13, lines 23-40.

Because Weiss provides a specific application of Lee's quantum dots, one of ordinary skill in the art would have found this application as motivation to combine the two references. Moreover, as discussed in the rejection of claim 204 above, the skilled artisan would have had a reasonable expectation of success in making the combination.

viii. Dependent claims 218, 220-221 and 223 are obvious

The only claimed element in claims 218 and 220-221 is the quantum dot already recited in base claims 198 or 206. Accordingly, because Lee and Weiss teach claims 198 and 206, they also teach claims 218 and 220-221.

Regarding claim 223, it recites an intended use of the quantum dot. But because the claim does not recite any structural limitations, it does not lay claim to a quantum dot that is distinct from the quantum dot in the base claim. Accordingly, because Lee and Weiss teach the base claim, they also teach claim 223.

Claims 219 and 222 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lee in view of Weiss as applied to claims 198 and 218 (or claims 206 and 221) above, and further in view of U.S. Patent No. 6,846,565 to Korgel *et al.* ("Korgel").

Lee and Weiss, described above, do not teach an alloyed quantum in a light emitting diode.

Korgel describes semiconductor nanoparticles capable of being implemented in light emitting diodes. *See* column 1, lines 37-47 and column 2, lines 44-59.

With the foregoing description in mind, one of ordinary skill in the art would have found it obvious to modify Lee and Weiss's quantum dots by placing them in a light emitting device. The skilled artisan would have a reason for performing this modification since Lee teaches that the quantum dots are applicable in any optical-electrical device (*see* column 1, lines 31-33) and an LED is one type of optical-electrical device. Moreover, Korgel teaches that applicable nanoparticles include those having the same semiconductor materials as Lee's quantum dots. *See* column 1, lines 45-47. Accordingly, the skilled artisan would have a reasonable expectation of success in placing Lee and Weiss's quantum dots in an LED.

Response to Arguments

Applicants traverse the rejection of the pending claims in the response filed February 26, 2010. All arguments have been considered. However, for the reasons below, Applicants' arguments are not sufficient to overcome the current rejections.

Applicants traverse the rejection of claims 198-199, 203-207, 210-215, 218, 220-221 and 223-224 over the Lee and Weiss references. Applicants first opine that the references do not teach the newly added limitation of a band gap energy that is "non-linearly related to the molar ratio of the at least two semiconductors." See page 11, first paragraph. However, as described above, this property appears to be an inherent characteristic of an alloy of two semiconductors. The specification suggests that the

mere fact of combining two semiconductors creates this property. *See* paragraph 0054 (describing that an alloy of CdSe and CdTe would produce an emission peak wavelength outside the emission peak wavelength of either one alone). As further proof that this is the case, Applicants state that the ratio of semiconductors comprising the claimed quantum dots "can be <u>any</u> molar ratio" (emphasis added). *See* paragraph 0046. Accordingly, if any molar ratio is sufficient to produce the claimed band gap energy, then a teaching of a combination of semiconductors will produce this phenomenon. Unless Applicants can prove that Lee's CdSeTe retains this same characteristic claimed, Lee teaches the limitation.

Applicants also repeat their argument that the Lee reference does not provide an enabling description for making the quantum dot mentioned therein. *See* page 11, second paragraph; page 12, third full paragraph to page 15, first paragraph. Against the previous Office Action's rationale for finding this argument not convincing, Applicants presented evidence in the specification describing a general method for producing the claimed quantum dot and examples of how to prepare the quantum dot, thereby suggesting that the specification provides more guidance than the Lee reference. See page 14. While the instant specification may provide more description regarding the production of concentration-gradient quantum dots, this alone does not invalidate a patent granted in this country. Under 35 U.S.C. 282, all claims in a U.S.-granted patent are presumed valid. Here, Lee is an issued patent and is therefore presumed valid as to all of its claims. The claims are directed to a nanocomposite material comprising a plurality of quantum dots, each quantum dot comprising a core and shell. *See e.g.*,

claim 24. The specification explicitly states that where there is a core and shell, there is an interface region that can comprise a gradual transition between the core and shell material. *See* column 7, lines 17-36. Accordingly, since the claim is broadly directed to a quantum dot with a core and shell, it includes the gradual transition interface region described by the specification. With this in mind, the Lee reference is a valid patent directed to a quantum dot teaching the same concentration-gradient limitation claimed by Applicants. Any argument questioning the enablement of such claims, including those made by Applicants against the enablement of the concentration-gradient, cannot therefore be entertained here.

Moreover, Applicants have not addressed the rejection under 35 U.S.C. 103(a) relying on Applicants' own specification admitting to the claimed alloy as prior art. *See* Specification, page 10, paragraph 0044, reciting "[s]uch semiconductors are known in the art, including for instance, $CdS_{1-x}Se_x$...wherein x is any fraction between 0 and 1." This type of admission can be relied upon in an obviousness rejection. *Riverwood Int'l Corp. v. R.A. Jones & Co.*, 324 F.3d 1346, 1354 (Fed. Cir. 2003); *see also* MPEP 2129. Accordingly, the claimed concentration-gradient quantum dot is considered obvious.

Applicants finally argue that even if the prior art teaches a method of preparing a concentration-gradient quantum dot, the cited references do not teach or suggest an emission wavelength outside the ranges of the two alloyed semiconductors. *See* page 15. Notably, the portion of Weiss Applicants rely on is merely an example of how the emission wavelength of a CdSeS semiconductor (between the emission wavelengths of CdS and CdSe) can be tailored and does not teach against emission wavelengths

outside of the emission wavelengths of CdS and CdSe. Indeed, Weiss generally teaches that varying the alloy of a semiconductor material is "old in the art" and gives the CdS and CdSe example merely "[a]s an illustration." To the contrary, one of ordinary skill in the art would recognize that if tuning semiconductor alloys is old in the art, it would have been obvious to tune the emission wavelength to the concentration-gradient quantum dot outside that of its component parts for the purpose of obtaining different optical properties.

For the foregoing reasons, Applicants' arguments are not convincing and the prior art rejections are maintained.

Conclusion

No claim is allowed.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Leon Y. Lum whose telephone number is (571) 272-2872. The examiner can normally be reached on Monday to Friday (8:30 am to 5:00 pm).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark L. Shibuya can be reached on (571) 272-0806. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Leon Y. Lum/
Examiner, Art Unit 1641

/Unsu Jung/
Primary Examiner, Art Unit 1641